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You have asked that I evaluate the language of the Regional Water Quality Control Board's proposed performance standard that recommends "Effectively attenuate significant increases in storm runoff. Runoff from vineyards shall not cause or contribute to downstream increases in rates of bank or bed erosion." (Table 4.1). Specifically, you ask about the Staff Report's interpretation of that mandate specifying limits on peak stormflow runoff of 10-15%.

Following are some analyses of this value and its enforceability.

Respectfully Submitted

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## Napa TMDL Suggested 10-15% Peak Flow Runoff Limitation Robert R. Curry October 19, 2008

## The 2007 version of the Regional Board Staff Report, on pp. 80-81 stated:

Hillside vineyard development at some sites, especially at those underlain by soft bedrock and/or where vineyards replace forest cover has also caused off-site channel enlargement (gully development) and associated shallow landslide failures31 (see source analysis this document; MIG, 2000). To avoid this problem when new hillside vineyards are proposed, the design review process should incorporate rigorous hydrological analysis (as appears to be the current practice by Napa County) to predict potential change in peak runoff rates, and the potential for off-site channel enlargement. Effective design features should then be incorporated to reduce off-site erosion risk to an acceptable level. A possible approach to this problem is outlined on pages 31- 37 of the *Phase II Final Report of the Napa River Watershed Task Force* (MIG, 2000).

Similarly, the Science Advisory Group to the Fish Friendly Farming Program has recommended that peak storm runoff rates following hillside vineyard development (at all sites) should not increase by more than 10-to-15 percent above pre-project rates to reduce the risk of off-site channel enlargement to an acceptable level (California Land Stewardship Institute, 2005). At all existing hillside vineyards, as part of a larger sediment source inventory and control plan, the potential for concentrated runoff from the vineyard or road network should be evaluated through site inspection and analysis by qualified registered professional scientists or engineers.

The goal for management of existing vineyards should be to reduce peak storm runoff rates into actively eroding gullies or landslides or other potentially unstable areas, as needed to accelerate natural recovery. Vineyard sediment control performance standards described above could be achieved through expanding the total vineyard acreage enrolled and independently certified under the Fish Friendly Farming Program32, by application of existing state regulatory authorities (Waste Discharge Requirements or Waivers thereof), and/or by adoption of some of the revisions to the Conservation Regulations that were recommended by the Napa River Watershed Task Force (MIG, 2000).

## This language was revised somewhat to strengthen the reference to the Fish Friendly Farming efforts for the contemporary version (2008) of that Staff Report as follows:

Hillside vineyard development at some sites, especially at those underlain by soft bedrock and/or where vineyards replace forest cover has also caused off-site channel enlargement (gully development) and associated shallow landslide failures31 (see source analysis this document; MIG, 2000). To avoid this problem when new and/or replanted hillside vineyards are proposed and permitted, the design review process should needs to incorporate rigorous hydrological analysis (as appears to be the current practice by Napa County) to predict potential change in peak runoff rates, and the potential for off-site channel enlargement. Effective design features should then be incorporated to reduce off-site erosion risk to an acceptable level to a less than significant level. A possible approach to this problem is outlined on pages 31-37 of the *Phase II Final Report of the Napa River Watershed Task Force* (MIG, 2000).

Similarly, the Science Advisory Group to the Fish Friendly Farming Program has recommended that peak storm runoff rates following hillside vineyard development (at all sites) should not increase by more than 10-to-15 percent above pre-project rates to reduce the risk of off-site channel enlargement to an acceptable a

less than significant level (California Land Stewardship Institute, 2005). At all existing hillside vineyards, as part of a larger sediment source inventory and control plan, the potential for concentrated runoff from the vineyard or road network should be evaluated through site inspection and analysis by qualified registered professional scientists or engineers. The goal for management of existing vineyards should be to reduce peak storm runoff rates into actively recovery avoid and control human-caused increase in sediment delivery from unstable areas.

In the Basin Plan amendment, we have formally recognized the Fish Friendly Farming Environmental Certification Program as an effective means of controlling pollutant discharges associated with vineyards. This recognition is based on farm plan reviews and site inspections completed by Water Board staff for approximately sixty vineyards in the Napa River watershed that have been Vineyard sediment control performance standards described above could be achieved through expanding the total vineyard acreage enrolled and independently certified under the Fish Friendly Farming Program32 during the past four years by application of existing state regulatory authorities (Waste Discharge Requirements or Waivers thereof), and/or by adoption of some of the revisions to the Conservation Regulations that were recommended by the Napa River Watershed Task Force (MIG, 2000).

You ask if we can avoid significant impacts if this 10-15% figure is adopted?

I have reviewed the basic peak-flow flood frequency data for the mainstem Napa River to see how this proposed constraint might affect bank stability and sediment transport issues below the hillside vineyard conversion areas. I note that the actual language of the proposed recommendation is focused not on the channels of the Napa River and its tributaries, but on the creeks and gullies that drain from the hillside areas undergoing vineyard conversions. In effect, the TMDL proposes to try to limit future runoff from hillside vineyards to 10-15% of pre-project conditions but does *not* directly address the "off-site channel enlargement" issues.

One question that is thus raised must be how control of individual vineyard developments may cumulatively affect downstream off-site channels. The value of 10-15% above pre-project conditions may be a rather arbitrary value that does not directly address downstream channel bank stability issues. Because channels in much of the Napa Watershed are already significantly disequilibrated, this proposed limitation on storm-flow runoff cannot be expected to do more that merely maintain current degraded conditions at best, and if it allows incremental increases of 10-15% for many new vineyard development projects, it can potentially lead to further cumulative degradation of the Napa River watershed. For example, if local groundwater levels are drawn down below the level of the bed of the Napa River or its valley-floor tributaries, as is commonly the case, then even a zero percent change in pre-project conditions may be too much to prevent further erosion of unvegetated channel banks. Pre-existing legacy conditions make channels more susceptible to erosion than they were in pre-development times.

The figure of 10-15% above background is commonly promoted in these kinds of natural phenomena cases based on the assumption that the natural variability

from century to century in hydrologic conditions (flood flows, hurricane frequency, rainfall intensity, etc.) have that kind of natural variability. Thus, geomorphologists' reason that a site or condition must have experienced that level of variation naturally in the past and maybe it can handle it again in the future. In other words, it is within the statistical envelope of the range of past conditions.

But of course, the assumption must be that only the flood runoff variable is being changed. The riparian vegetation and depth of channel incision and duration of storm flows would have to remain at pre-project levels to allow tolerance for a 15% increase in storm flood runoff. The problem is that the effects are additive and groundwater withdrawal, paving and urbanization, stream incision due to past storm-flow changes and dams on tributaries, loss of riparian protection, etc., etc. all are cumulative. Hydrologically, you can't change only one thing.

A second concern is that by focusing only on the vineyard development sites for this part of the TMDL, legacy conditions in the channels, runoff generated from other non-vineyard developments, and indirect effects such as riparian community losses, changed channel form (incision), and reduced sediment supply (dams); all cumulatively reduce tolerance for increased storm runoff. Vineyards are a source of new sediment and runoff, but is a control of 85 to 90% of the new vineyard contributions adequate to meet the requirements of the TMDL?

I have considered what 15% change may mean to the mainstem Napa River. To look at this in perspective, we may consider what 15% of current (not-preproject) conditions may mean to the Napa River at St Helena. The attached graphic is a plot of flood magnitudes versus frequency for that site for the water- years 1982 to 2004. By focusing on this relatively recent peak flood flow record rather than the 60+ years of total record, we more realistically consider the cumulative effects of dams and urbanization from the 1980's to the present. Most hydrologists would agree that the proposed 15% hillside vineyard runoff constraints will most likely be locally effective for the smaller, more-frequent, storms in the vineyards themselves. However, the effects of long-duration (several-day) cumulative rainfall events that may have a recurrence magnitude of 50-100 years are much less predictable with the current models.

The TR-55 computer program used by conversion consultants easily calculates a runoff value for a 24-hour period for an isolated storm of these infrequent magnitudes but cannot in fact assess large-magnitude runoff events because they are almost always associated with multi-day storms of longer than 24-hours duration. The model is restricted to applications for small watershed areas only, without multiple contributing areas. For longer-duration storms, the soil infiltration capacity and ability of a site to temporarily store water on a hillslope are exceeded and the runoff generated by each added inch of rainfall is substantially greater than it was for the first 24-hours under natural field

conditions. Thus, it is not possible to predict post-development runoff with the 24-hour small-watershed TR-55 model for large storms of multi-day duration, no mater how large the watershed. In practice, small watersheds at the vineyard scale must be assumed to fully saturate in 24-hours so that further rainfall does not change the runoff peak volume. This works well to calculate storm runoff from a shopping center, but not from a topographically complex 1000-acre vineyard where newly-constructed sediment basins and energy dissipaters may fill with water during an initial storm and then contribute runoff to a larger storm a few days later.

Looking only at 2-year (average annual) and 10-year return-period instantaneous peak runoff values for the Napa River at St. Helena, we calculate the following:

Two Year Return Flow: 5542 cfs; 15% is ±831 cfs; Standard Error of estimate 3928 cfs to 7818 cfs Ten Year Return Flow 13210 cfs, 15% is ±1981 cfs; Stnd Error - 9761-17876 cfs

What this means is that a total 15% increase in peak flood-flow magnitude for 2-10 year magnitude events would be lost in the statistical noise by the time you looked at the mainstem Napa River.

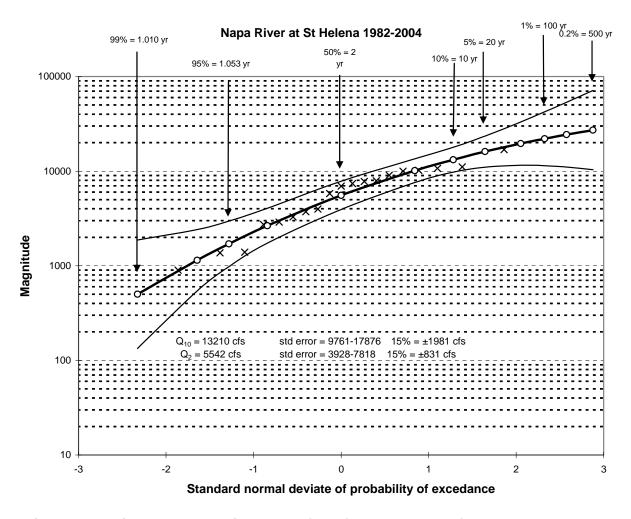


Figure 1. Mainstem Napa River peak flow frequency plot for Log-Pearson Type III analysis restricted to 1982-2004 water years.

Looking at the downstream receiving waters in the Napa River, we would have a difficult time proving that a cumulative 15% increase in peak flow values had occurred, based on the current stream gauging network. The Standard Error of the Log-Pearson extreme-value estimates is insufficiently precise to detect a 15% change. Even if we assumed a statistically normal distribution with a smaller standard deviation, net changes may not be detected. This is just the way that rivers and their complex alluvial flood plains work when storms of differing magnitudes, different durations, and different antecedent conditions result in runoff.

The 15% flood-flow limitation is a headwater target value only. It cannot protect downstream channels from bank erosion and/or channel scour when considered in combination with other similar vineyard developments and non-vineyard runoff increases. Using our current gauging station network that is located on main tributaries and the Napa River itself, we probably cannot expect to even detect direct increases of 10-15% in headwater hillslope runoff areas. New local

stream gauging and erosion effectiveness monitoring will be necessary to assure that the 10-15% figure is in fact being met. The 10-15% limitation can only be expected to be effective at headwater source areas, not at downstream sites where the channel may already be incised or the riparian community already compromised. In general, where two or more ephemeral tributary watercourses join, the site is no longer considered a headwater. Drainage swales that only carry water during storms that reoccur every three or more years and the ephemeral channels that may carry runoff during annual winter storms are considered headwater channels, and it is these features that may be effectively protected with the 15% runoff limitation.

If the 15% standard is to be effectively implemented to *effectively attenuate* significant increases in storm runoff, there must be a provision for monitoring on the scale of small watersheds of 1-5 square miles area, and that monitoring must be able to be carried out for a sufficient time (perhaps 20 years) to provide defensible sound data collection. Meaningful data can be collected in a few years, but the program should attempt to capture the range of storm runoff conditions that can be expected in a longer period. Monitoring must include both the effectiveness of on-site cover-crop implementation and downstream offsite channel stability. A TMDL is incomplete without monitoring and validation.

The Napa County Hillside Vineyard Conversion issues have attracted many good scientists who can develop the necessary monitoring protocols.

## Conclusion:

Control of 85-90% of the contributions storm runoff from new hillside vineyards cannot prevent exacerbation of pre-existing storm-flow runoff damage to receiving water channels, nor can it prevent future new damage where multiple conversions, development, or increased vineyard acreages are contemplated in a single watershed.